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Novel Indicators of the Trade and Welfare Effects of Agricultural Distortions in OECD Countries

Empirical indicators of farm support by governments and their effects on consumer prices, called Producer and Consumer Support Estimates (PSEs and CSEs), have been estimated in a consistent way since 1986 by the Secretariat of the OECD (2009) for its 30 member countries. The indicators provide policy transparency, contribute to a better understanding of the various dimensions of agricultural support measures in high-income countries, and have been used extensively as inputs into economic models of agricultural markets. The OECD (2006) has also released PSEs for Brazil, China and South Africa, as well as for several East European countries; and it will soon add them for Chile.

A recent global World Bank study (Anderson 2009) complements and extends the OECD's efforts by providing similar estimates for a longer time period (back to 1955) and for individual member countries of the European Union. It also has comparable estimates for 45 other countries at different stages of economic development and includes a time series of rates of assistance to producers of non-agricultural goods, to compare with agricultural distortion estimates.

The OECD and World Bank measures for each product are aggregated using the value of production and consumption as weights to obtain an annual average PSE and CSE for each country. That traditional aggregation method provides a reasonable indicator of the average price distortion across that country's product set, but it is not necessarily a good indicator of the distortion to the volume of trade in farm products because that depends also on the responsiveness of domestic supply and demand to price changes (that is, price elasticities), and on whether there are any negative PSEs that are offsetting positive ones in the aggregating process. It is an even poorer indicator of the national welfare cost of that country's farm price and trade policies, because for each product that cost is related to the *square* of the rate of price distortion and so the total cost depends on the extent of dispersion in product PSEs and CSEs.

Certainly one can use the OECD or World Bank price distortions as inputs into national partial or general equilibrium models to estimate the trade- and welfare-reducing effects of a country's agricultural policies. However, such models are computationally intensive, and the results can be contentious if there is no consensus on what model specification and parameters such as elasticities to use. Even more problematic is that typically they are calibrated only for a particular past year and so are not able to provide a time series of estimated economic effects.

An alternative is to use the raw data in the OECD and World Bank studies to calculate indexes of the trade- and welfare-reducing effects of policies. Anderson and Neary (2005) specify a simple, elegant and theoretically meaningful methodology to provide such measures as a supplement to aggregate PSEs and CSEs.

The goal of this paper is to demonstrate how the Anderson-Neary methodology can be applied using no more information than that assembled already to generate price distortion estimates for OECD member countries. The method may have been ignored to date because it was traditionally thought that price elasticity estimates were necessary to estimate such indices. However, it has recently been shown by Lloyd, Croser and Anderson (2010) that by assuming domestic price elasticities of supply are equal across commodities within a country, and likewise for price elasticities of demand, the index number formulae simplify to a share-weighted function using shares of production and consumption as weights. The resulting measures thereby can be generated as supplements to the current policy monitoring indicators generated by the OECD Secretariat without having to tackle the contentious questions associated with the size of price elasticities (such as whether they refer to the short or long run) and without having to continually update a sector or economy-wide model.

Drawing on the Anderson and Neary framework, we estimate two indexes which go by the precise descriptors of a trade reduction index (TRI) and a welfare reduction index (WRI). The TRI and WRI are each computed from sub-indices of the production and consumption sides of the market (the Producer and Consumer Distortion Indexes, PDI and CDI), which are derived from nominal rate of assistance (NRA) and consumer tax equivalent (CTE) estimates for individual products, respectively, from the World Bank's database.[1] NRAs to producers and CTEs to consumers differ whenever there are domestic subsidies or taxes on production or consumption in addition to border measures. Thus the indexes capture in a single scalar number the aggregate trade- or welfare-reducing effects of all policies directly affecting consumer and producer prices of farm products from all measures in place. Non-product-specific distortions are not captured in the indices, which by construction aggregate only product-specific data. However, we attempt to gauge the importance of this limitation in the final section of the paper.

The present paper is aimed at encouraging not only the OECD to add these indexes to their current set of indicators calculated each year, but also developing country governments or policy think-tanks to generate them so as to be able to monitor each year the trade and welfare effects of their national policies. A new FAO/OECD project, funded by the Bill and Melinda Gates Foundation and getting under way in 2010, aims to estimate agricultural policy indicators for a large sample of poor African countries over the next few years. Since many of those countries do not have a sector or economy-wide model of their economy, the two indicators outlined in this paper could provide at least a partial equilibrium indication of the effect of national policies in reducing agricultural trade and national economic welfare. They could then be compared with those provided in the present paper for high-income countries.

The paper begins with a presentation of the methodology for computing partial-equilibrium trade and welfare reduction indexes. It then outlines the data in the World Bank's database, which are used for computing the indices. Next, the index results are presented and discussed, following which is a section addressing several caveats. The paper concludes with lessons learned and areas for further research.

Methodology

There is a growing literature that identifies ways to measure the trade- and welfare-reducing effects of international trade policy in scalar index numbers. This literature serves a key purpose: it overcomes aggregation problems (across different

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[1] NRAs and CTEs are similar to PSEs and CSEs, except they are expressed as a percentage of the undistorted price whereas PSEs and CSEs are expressed as a percentage of the distorted price (and the CSE has the opposite sign to the CTE).

intervention measures and across industries) by using a theoretically sound aggregation procedure to answer precise questions regarding the trade or welfare reductions imposed by each country's agricultural or trade policies. The goal of the literature is to generate a single indicator that captures the overall trade or welfare effect of an individual country's regime of price distortions in place at any time, and to trace its path over time and make cross-country comparisons.

The pioneering work in the literature is by Anderson and Neary (summarized in their 2005 book). Feenstra (1995) simplified the methodology to a partial-equilibrium framework. These two authors define a Trade Restrictiveness Index as the ad valorem trade tax rate which, if applied uniformly across all tradable agricultural commodities in a country, would generate the same reduction in welfare as the actual cross-product structure of distortions. They also define a Mercantilist Trade Restrictiveness Index (MTRI) as the ad valorem trade tax rate which, if applied uniformly across all tradable agricultural commodities in a country, would generate the same reduction in international trade as the actual cross-product structure of distortions.

In recent years, several empirical papers have provided various series of partial-equilibrium estimates of scalar index numbers for individual countries. Irwin (2010) uses detailed tariff data to calculate the Trade Restrictiveness Index for the United States in 1859 and annually from 1867 to 1961. Kee, Nicita and Olarreaga (2009) estimate a series of indices for trade policies of 78 developing and developed countries for a single point in time (mid-2000s). Lloyd, Croser and Anderson (2010) modify the Anderson/Neary TRI and MTRI methodology to make it more applicable to agricultural policies, and show how it can be greatly simplified if certain assumptions about elasticities are adopted. Croser and Anderson (2010) build on that to develop a methodology for computing scalar index measures for individual policy instruments, which can be compared across instruments to see the relative contributions of different policy instruments to overall reductions in trade and welfare. In addition to being useful to summarize policy in an individual country, the Anderson-Neary scalar index measures has been adapted to measure the trade- and welfare-reducing effects of policy in a regional or global commodity market (Croser, Lloyd and Anderson 2010). In this paper we utilize the methodology in those latter three studies to generate a series of indicators of the trade- and welfare-reducing effects of agricultural policies in OECD countries over the past half century.

The remainder of the methodology section outlines the method for constructing three types of indexes: the Anderson-Neary type indexes for individual countries; instrument level indexes for individual countries to gauge the importance of different policy measures in the overall degree of agricultural policy distortions of OECD countries; and commodity market indexes for that group of countries.

Country level trade and welfare reduction indexes

To capture distortions imposed by each country's border and domestic policies on its economic welfare and its trade volume, we adopt the methodology from Lloyd, Croser and Anderson (2010). These authors define a Welfare Reduction Index (WRI) and a Trade Reduction Index (TRI), each of which can be estimated by considering separately the distortions to the producer and consumer sides of the economy (which can differ when there are domestic measures in place in addition to or instead of trade measures). As their names suggest, the two indexes respectively provide a single empirical indicator of the (partial equilibrium) welfare- or trade-reducing effects of distortions to consumer and producer prices of farm products from all agricultural and food policy measures in place.

The Lloyd, Croser and Anderson (2010) methodology requires data on the production and consumption sides of the economy separately. Since PSE and CSE information is available from the OECD on an annual basis, this methodology is well suited to focusing on the trade and welfare effects of agricultural and trade policy in OECD member countries. Indeed it provides something closer than the PSE or CSE to what a sector or economy-wide computable general equilibrium model can provide in the way of estimates of the trade and welfare (and other) effects of price distortions, while having the advantage of providing an annual time series.

The derivation of the measures in Lloyd, Croser and Anderson (2010) for *n* import-competing sectors leads to the expressions in Box 1 for the TRI and WRI for the import-competing sector of a country. The import-competing TRI and WRI are constructed from appropriately weighted averages of the level of distortions of consumer and producer prices. The same weights are used to construct both indexes, but the TRI is a mean of order one measure, while the WRI is a mean of order two. Because the WRI is a mean of order two, it better reflects the welfare cost of diverse agricultural price-distorting policies than the PSE or CSE since it captures the disproportionately higher welfare costs of peak levels of assistance or taxation. The

WRI is positive regardless of whether the government's agricultural policy is favoring or hurting farmers.

The TRI and WRI can be readily extended to accommodate distortions to exported and nontradable agricultural goods (Lloyd, Croser and Anderson 2010). Separate sub-indices for each sub-sector are computed, and aggregated using sector values of production and consumption at undistorted prices as weights. Distortions to exportable industries enter the TRI aggregations as negative values because a positive (negative) price distortion in an exporting industry has a trade expanding (reducing) effect, and thus should decrease (increase) the TRI. Distortions to nontradable industries are assumed to be zero in the TRI aggregation because a domestic price distortion in a nontradable sector is assumed to have neither a trade expanding nor trade reducing effect because of the presence of high trade costs.[2]

Elasticities of supply and demand are required to compute the TRI and WRI expressions in Box 1. However, if one is willing to assume that price elasticities of supply (demand) are equal across commodities within a sub-sector or sector of an economy, then the elasticities in the numerator and denominator of the index weights cancel. This powerful simplifying assumption gives an expression for the TRI or WRI which is simply an appropriately weighted aggregate of distortions on production and consumption sides of the market. It is found by aggregating the change in consumer (producer) prices across commodities and using as weights the sector share of each commodity's domestic value of consumption (production) at undistorted prices. That is, with this elasticity assumption, these indexes are attainable with the same information used to estimate the PSE and CSE (or NRA and CTE, which are similar except expressed as a proportion of the border price rather than the distorted domestic price). Yet they provide a better indication of the trade- or welfare-distorting effects of those producer and consumer price measures.

A second assumption is made in the empirical part of the paper when aggregating across all OECD countries. It is to assume that the marginal responses of a country's supply and demand to a price change are the same in aggregate for the sector. More precisely, we assume (see Box 1) that a=b=0.5, where the weight a (or b) is proportional to the ratio of the marginal response of domestic demand (or

[2] This is consistent with the partial equilibrium nature of the indexes being generated here. In a general equilibrium model there could be indirect trade effects via the impact of distortions to nontradables on factor markets.

supply) to a price change relative to the marginal response of imports to a price change.

Other trade and welfare reduction indexes

The country level TRI and WRI measures reported below aggregate the trade- and welfare-reducing effects of a wide range of policy measures. The variables s_i and r_i in Box 1, as domestic-to-border price ratios, can theoretically encompass distortions provided by all trade tax/subsidy measures and quantitative restrictions on trade, plus domestic price support measures (positive or negative), plus direct interventions on inputs; and, where multiple exchange rates operate (as in numerous developing countries in the past), the measures can encompass an estimate of the import or export tax equivalents of those distortions.

While it is desirable to have a country level indicator that encompasses all of these distortions, agricultural policy analysts are sometimes interested in the relative contribution of different policy instruments to reductions in trade or welfare. To provide this insight, it is possible to use the Anderson-Neary framework to construct indicators of policy distortions at the instrument level and compare indices across instruments.[3] Croser and Anderson (2010) define an Instrument Welfare Reduction Index (IWRI) and an Instrument Trade Reduction Index (ITRI), which can be estimated by considering the distortion from a single policy instrument to the producer and consumer sides of the economy. They develop their methodology for four types of border distortions (import taxes and subsidies, and export taxes and subsidies) and for a series of domestic distortions in the form of production, consumption and input taxes and subsidies.

One of the limitations of the ITRI and IWRI in the context of OECD countries is that, by construction, non-product-specific measures are not included in the estimates because such supports are not reported at the product level. However, non-product-specific measures are clearly important for the overall story of agricultural policy in some OECD countries (reported below), as a result of a move in recent

[3] This issue is not one that has been explored in the existing literature because most of the Anderson-Neary type indexes are estimated for single policy instruments. Irwin (2010), for example, uses only import tariffs. Kee, Nicita and Olarreaga (2009) report two series of indices, one based on tariffs only and the other on tariffs plus non-tariff import barriers. While they may be the dominant instruments for non-farm products, the agricultural sectors of OECD countries have been subject also to numerous domestic and export subsidies; and, in developing countries, agricultural production and export taxes also have been used.

decades to forms of support at least somewhat decoupled from production. Notwithstanding this limitation, below we estimate the trade- and welfare-reducing effects of individual policy instruments. We assume that border measures are applied first, and this may be supplemented by additional domestic distortions. This allocation assumption provides an upper-bound on welfare losses from border measures and a lower bound on welfare losses from domestic measures. An attempt is made in the empirical section below to gauge the potential importance of non-product-specific support measures which are excluded from the formal ITRI and IWRI measures.

We also report commodity level TRI and WRI indexes below, which give the aggregate trade- and welfare-reducing effects of OECD member country policies to individual commodity markets. These indices are computed using a methodology similar to that in Box 1, but where distortions are summed across countries for an individual commodity, instead of across commodities for an individual country. Croser, Lloyd and Anderson (2009) provide a detailed exposition of the methodology as it applies to individual commodity markets globally. Below we provide them for the subset of countries that are OECD members.

Data

This study makes use of data from the World Bank's Distortions to Agricultural Incentives database (Anderson and Valenzuela 2008). For high-income countries that database drew on the OECD's PSE and CSE series (OECD 2009) for the period since 1986, but extended the time series back to 1955 for many countries. In the case of the European Union, whose membership expanded several times over the past half century, the World Bank study provides distortion estimates by country on the assumption that the estimated EU-wide PSE and CSE for each product applied in each member country (see Josling 2009). Differences across EU countries in the overall sector distortion indicators are thus due to differing commodity shares in sector production and consumption.

We focus on a subset of OECD and other countries in the World Bank database (hereafter called the focus countries): 15 Western European countries, all of which are OECD member countries;[4] 13 of Europe's transition economies, five of which are OECD member countries;[5] and six other high-income OECD member countries: Australia, Canada, Japan, New Zealand, the Republic of Korea, and the United States. The OECD member countries that are not included in the focus countries sample are Belgium, Greece and Luxembourg (for which NRA estimates are not available and Mexico (a recent and much poorer member).

The database contains annual estimates of nominal rates of assistance (NRAs, positive or negative) and consumer tax equivalents (CTEs) for key farm products. The NRA and CTE estimates in the database are at the commodity level and cover a subset of 39 agricultural products in the OECD. These so-called covered products account for around three-quarters of total agricultural production over the period studied. The database identifies the extent to which each commodity in each country each year is import or export dependent or a nontradable (which may change over time). For the 34 focus countries, the database contains around 16,000 consistent estimates of annual NRAs to the agricultural sector and the same number of CTEs between 1955 and 2007. Since not all countries have estimates for the 1950s, we report estimates below starting from 1960.

The range of policy measures incorporated in the NRA estimates in the database is wide. By calculating domestic-to-border price ratios, the estimates include assistance provided by all tariff and nontariff trade measures at each country's border, plus any domestic price support measures (positive or negative), plus an adjustment for the output-price equivalent of direct interventions on inputs. Where and when multiple exchange rates operated, estimates of the import and export tax equivalents of that distortion are included as well. The range of measures included in the CTE estimates includes both domestic consumer taxes and subsidies and trade and exchange rate policies, all of which drive a wedge between the price that consumers pay for each commodity and the international price at the border.

Analytical narratives of agricultural policies for the last five decades in the 34 OECD countries are provided in Anderson (2009). This book reports on the data in the Distortions to Agricultural Incentives database, and contains case studies for specific regional groupings. The book reports on measures such as unweighted and

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[4] Austria, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK.
[5] Bulgaria, **Czech Republic**, Estonia, **Hungary**, Latvia, Lithuania, **Poland**, Romania, Russia, **Slovakia**, Slovenia, **Turkey** and Ukraine (OECD member countries in bold).

weighted mean NRAs, standard deviations of NRAs, weighted mean NRAs for exportable versus import-competing covered products, measures of the trade bias of the agricultural sectors' covered plus non-covered tradable products, and relative rates of assistance.

Josling (2009) provides an analysis of agricultural and trade policy distortions in Western Europe over the past 50 years. The analysis covers 18 countries, using data that has been disaggregated in some instances from regional aggregates. The aggregate NRA and CTE results from this study are reported at the country level in Tables 1 and 2. (Appendix Table 1 lists the changing membership of the regional EU and EFTA blocs.) It confirms that Western European agricultural policy is characterized by high levels of assistance throughout the postwar period, albeit with declines for some countries since the mid-1980s. The latter is largely due to some re-instrumentation of agricultural policy away from import protection for specific commodities toward direct payments that are supported for socially responsible farming.

Anderson and Swinnen (2009) summarize agricultural policy in 18 of Europe's transition economies, drawing on their more-detailed book (Anderson and Swinnen 2008). Despite the heterogeneity of reform experiences, they note some overall patterns. In the early 1990s, when reliable data for these regions are first available, support to agriculture is at reasonably low levels. This is because many trade and price distortions were removed throughout the region at the start of the reform period in the early 1990s. Since that time, changes in agricultural policy have tended to be characterized overall by stop-go phases, and sometimes reversals of previous reforms. In 2000–07, NRAs were on average higher than they were in the decade of the 1990s.

Honma and Hayami (2009) provide a study of agricultural policy in Northeast Asia over the past 50 years, illustrating the dramatic growth that can occur in distortions to agricultural incentives as real incomes grow. Distortions in these two countries are currently at high levels, driven by border protection for import-competing food products.

North America's and Oceania's lower levels of agricultural policy distortion contrast with those of Europe and Northeast Asia. In the US and Canada, real spending on agricultural support has not diminished greatly over time (Gardner 2009). By contrast, in Australia and New Zealand, there was a rapid dismantling of agricultural policy support from the 1980s, which has resulted in Oceania having the lowest levels of distortion among OECD countries (Anderson, Lattimore, Lloyd and MacLaren 2009).

The country level aggregate measures in Tables 1 and 2 hide the degree of variation in commodity NRA and CTE estimates within countries. The case studies in Anderson (2009) report standard deviations around weighted mean NRAs for covered products in each country, showing that variation to be significant and not declining. One indication of the extent of variation between groups of products is provided by a comparison of the average NRA for import-competing and exportable product groups. The extent of this variation is shown in aggregate for EU countries and the 34 focus countries in Figure 1. There is a significant gap between the average NRA for import-competing and exportable products over the period shown, which reflects the extent of antitrade bias that has also persisted through time except for the most-recent period when international agricultural prices were rising.

Notwithstanding the valuable contribution of the measures reported in the case studies in Anderson (2009), sector averages of NRAs can be misleading as indicators of the aggregate extent of price distortion within the sector as it affects trade and welfare. They can also be misleading when compared across countries which have varying degrees of dispersion in their NRAs for farm products. Hence the need for supplementary TRI and WRI series for the additional insights these measures can provide.

TRI and WRI Estimates

Table 3 reports the TRI estimates for all covered farm products from 1960 to 2007 for all 34 focus countries and six regional groupings. For all of the regional aggregations except Oceania, agricultural policy overall was trade-reducing, with Northeast Asia and Western Europe experiencing the largest reductions in trade. The regional aggregations hide some of the country level variation in agricultural policy, however, and there were even some decades in which policies were trade expanding in some countries, for example Finland, Sweden and several transition economies in addition to Australia and New Zealand.

The TRI time series for the focus countries and the EU group are shown against the NRA time series in Figure 2. The most striking observation for these groupings is the close correlation between the TRI and NRA series. This result is driven by the dominance of the import-competing sector in each of these two aggregations. The close correlation between the two series need not always result, however. Oceania provides a counter example, where the TRI has the opposite sign to the NRA aggregates, indicating that trade policy overall in Oceania was trade expanding despite positive NRA aggregates, because there was positive assistance to Australia's (and in some time periods New Zealand's) dominant export sub-sector. Another example of where the correlation between the TRI and NRA breaks down is in the time period 1980–84 to 1985-89. The NRA is increasing for 34 focus countries, from around 40 to 60 percent, while the TRI falls in this period by a similar amount. Agricultural policies in the focus countries were on aggregate becoming less trade restrictive in this period (even though the NRA is increasing) because assistance was increasing for exportable products, in the form of export subsidies.

The WRI results reveal that over the period shown the aggregate NRA measure greatly understates the extent of welfare losses from agricultural and trade policies (Figure 2 and Table 4). Figure 2 shows that for EU countries the extent of understatement is greatest in the 1970s, and for the 34 focus countries the understatement is greatest in 1985–89. These large gaps coincide with world price-spikes. The 1985–89 period is when a downward price spike resulted in import-competing products being more distorted relative to export products, and conversely for the 1975–79 period.

The fall in the WRI for EU countries is dramatic following the peak in the early 1980s, and more dramatic than the fall in the EU's aggregate NRA over the same time period (Figure 2). From the peak in 1980–84, there is a fall in both the weighted mean and the weighted variance of producer (consumer) distortions. Thus, the two elements of the WRI are falling, resulting in a steeper decline in the WRI than the NRA. This shows one of the benefits of generating a WRI: it provides a better sense of welfare improvements from policy reforms that reduce assistance to covered farm products. It should be noted, however, that from the mid-1980s, OECD members moved towards a re-instrumentation of agricultural policy, which is not fully reflected in the WRI and TRI estimates presented in Figure 2 (see next section).

The individual country WRI results are presented in Table 4. They are necessarily always above the TRI and the average of the NRA and CTE measures, and are always positive because they are means of order two. There is considerable variation in the extent of welfare reductions in policy over the period shown. In Western Europe, most countries have seen a decrease in their WRI in recent decades. For some countries this comes after a peak in the 1980s – such as in France, Ireland and Italy – whereas for other countries there has been more of a continual decline, as for example in the United Kingdom, Germany, Netherlands and Sweden. Norway, Switzerland and Iceland stand out among Western Europe countries for their exceptionally high WRIs, although these countries have experienced the steepest declines in recent decades. Canada's WRI series is notable for its large increase above the NRA aggregate in the 1980s (when there was a large increase in the dispersion of its NRAs around the weighted mean).

The country-level WRI measures, which are derived using an overall measure of the distortion to producer and consumer prices in individual sectors of the 34 focus countries, masks the contribution of different policy instruments to welfare losses in each country. Figure 3 reports the decomposition of the overall country WRI by policy instrument for the 6 key regional groups. The decomposition is found by estimating WRI series for individual policy measures, and then apportioning the shares of these series to the overall WRI. In our 34 focus countries as a whole, border measures – which distort both producer and consumer prices – are by far the most significant of the distorting policy instruments. They account for upwards of 90 percent of the welfare losses in all 6 sub-regions over time, with the proportion being above 97 percent in most instances.

The decomposition of border measures in Figure 3(a) shows that import tariffs are the dominant measure of distortion in terms of market price support in most regions. In the European Union and Northeast Asia, in particular, import taxes dominate border supports. In EFTA countries, import tariffs also dominate but these countries together also have significant export subsidies. Oceania has significant export subsidies in 1980–84, but they are reduced over time along with other reductions in policy distortions in those countries. Data are available only from 1992 for Eastern Europe's transition economies. In 2000–04, this sub-region has a range of distortionary policy instruments in use: import taxes dominate, but export taxes and subsidies are also present.

The final perspective from which to consider the trade- and welfare-reducing effects of policies in our 34 focus countries is at the commodity market level, for individual commodities. Figure 4(a) shows that rice is the most distorted commodity market across the 34 focus countries. This is followed by a group of vegetable products, which are heavily protected in Japan and Korea. The sugar, oilseed, milk, beef and cotton markets are the next most heavily distorted markets. The results for just the EU market indicate that sugar and livestock products are most heavily distorted in that region.

Caveats and Sensitivity Analysis

Some important caveats need to be mentioned, because the paper's two main indexes have been calculated with the help of a number of simplifying assumptions. One key assumption is that each country's own-price elasticity of supply (and also of demand) for a particular product is the same as that for every other product, and that cross-price elasticities are zero. It is not uncommon for modelers of the global market for particular farm products to adopt these assumptions, for want of reliable or agreed econometric estimates of those elasticities for each country (an early global example being Valdés and Zietz 1980). Anderson and Neary (2005, p. 293) observe that price elasticities are 'not very influential' in affecting trade restrictiveness indices because elasticities appear in both the numerator and denominator of the indices (see Box 1). In the present case, too, this assumption is expected to have only a small effect on the results. Kee, Nicita and Olarreaga (2009) show that Anderson-Neary type indices can be decomposed into three elements: the weighted mean of distortions, the weighted variance of distortions, and the covariance between each distortion and its relevant elasticity scaled by the weighted average relevant elasticity. In empirical work, Kee, Nicita and Olarreaga (2009) note that the contribution of the covariance term to their estimated trade restrictiveness indexes is very small in practice. Irwin (2010) in his study for the United States similarly shows that the covariance is a very small factor relative to the average tariff and variance of the tariff.

Notwithstanding those expectations, to gauge the potential importance of not allowing differential price responses, we re-compute our two country-level indexes using country- and commodity-specific own-price elasticity of supply and demand estimates available for 27 key farm products from widely cited sources (Roningen 2001; Tyers and Anderson 1992). A comparison in Table 5 of those results with the earlier estimates made with the simplifying elasticity assumption reveals some differences in the overall indications of distortions. The biggest divergences are for

Korea and Japan, where the average WRI across countries using the elasticity data is between 6 and 46 percentage points lower than estimates without elasticity data. It should be noted, however, that this is off a high base of WRI averages of over 100 percent in many instances. The Western European countries also have a fairly significant change in their TRI and WRI estimates. The elasticity values for this region reveal that livestock products tend to have a higher (absolute) elasticity of supply and demand, while grains and tropical crops have elasticities lower than the average.[6] As such, including elasticity estimates results in livestock products in the EU having a higher weighting than grains and sugar. There is little divergence in the results with and without the simplifying elasticity assumption for North America and Oceania, which have relatively low TRI and WRI estimates. Despite the differences reported in Table 5, it is clear that in all cases, the index trends over time are much the same under either set of elasticity assumptions, and they give a better indication of the trade reduction and welfare losses from agricultural policies than standard weighted aggregates of NRAs and CTEs.

Our other assumption — that the aggregate marginal response of domestic demand to a price change is the same as the aggregate marginal response of domestic supply— might also have an impact on the results. We re-compute our two indexes assuming that demand was instead twice, or half, as responsive as supply. Despite that wide range, the estimates were almost unchanged at the aggregate level across the six regional groups. This benign result is due to the empirical fact that the producer and consumer distortions are similar, reflecting the dominance of border measures in the policy instrument mix.

A third caveat on the results for the TRI and WRI by policy instrument is the exclusion of non-product-specific (NPS) distortions in the estimates. In the Anderson and Valenzuela (2008) database, NPS assistance can be a significant component of overall agricultural sector distortions in some OECD countries. NPS is reported in three forms in the database: general NPS assistance, input subsidies that are not

[6] Thus the size and ranking of the commodity indexes for the OECD country group, summarized in Figure 4, also would be affected somewhat by using differential elasticity estimates. Croser, Lloyd and Anderson (2010) examine this at the global level for eight major agricultural products and find that, if the elasticities found in Tyers and Anderson (1992) are used, there is little difference in the overall indications of distortions: the index averages using the elasticity estimates are 5 percentage points lower than the estimates using the simpler elasticity assumptions for one decade, but are between just 0 and 3 points lower for the other seven decade averages shown. Not surprisingly the differences are largest for the product with the most diverse NRAs, namely rice. In all cases, the global commodity index trends over time are much the same under either set of elasticity assumptions.

attributable at the product level, and decoupled payments. Recall that the ITRI (or IWRI) is defined as the ad valorem trade tax rate which, if applied uniformly across all tradable agricultural commodities in a country, would generate the same reduction in trade (or same economic welfare loss) as the actual cross-product structure of NRAs and CTEs for that country. A simple assumption to incorporate NPS measures is that all of the NPS distortions is enjoyed by producers and that they have no impact on consumer price distortions. This assumption allows us to provide, in Figure 3(b), an upper bound on their potential effect on the Producer Distortion Index (PDI) component of the ITRI or IWRI.[7] Figure 3(b) shows the results of adding in this way all NPS assistance to the Producer Distortion Index. On the one hand, decoupled support and general NPS support – if equivalent to an increase in product prices for farmers – would make up almost one-third of distortions in EFTA and EU countries in 2000–04, and only slightly less in North America. On the other hand, if those forms of support were truly decoupled and had no impact on farmers' incentives, the PDI would be unaffected and hence the WRI would be as in Table 4. The potential importance of NPS for the WRI is thus somewhere in that range. The WRI and TRI series need to be interpreted in the light of the uncertainty associated with their omission of NPS measures.

Conclusions

This paper presents a case study of the application of new theory-based policy indicators to monitor the changing extent of policy interventions that reduce international trade and national economic welfare in OECD countries. It reports estimates of the indicators for each OECD country over the past half century as a way of illustrating the prospective use of this methodology as a supplement to the annually released PSE/CSE indicators of the OECD. The paper also shows that the methodology can be used to gain better insight into the trade and welfare reductions in individual commodity markets across OECD countries, and those reductions by individual policy instruments.

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[7] For example, if the IWRI of all border measures is 30 percent, and the country also gives farmers decoupled payment support of 20 percent, it is incorporated by assuming an overall country WRI of 50 percent.

In the past, trade and welfare reduction indicators have not been reported as part of the OECD regular monitoring activities. This may have been because it was thought that economic models and elasticity data would need to be agreed upon, which would raise technical and political problems. The measures we estimate in this paper are such that one can avoid the need to select a pair of price elasticity estimates for each product of each country. As such they could provide an attractive and politically uncontroversial supplement to the current policy monitoring indicators generated by the OECD, and by other multilateral institutions such as the FAO, UNCTAD, World Bank and the WTO.

The importance of TRIs and WRIs will also be relevant for a new FAO/OECD project, funded by the Bill and Melinda Gates Foundation and getting under way in 2010, which aims to estimate agricultural policy indicators for a sample of African countries over the next few years. In African countries, different policy instruments operate such that the TRI could have a different sign in some years to the NRA aggregate (because of, for example, export taxes). Furthermore, if there is no economy-wide model for some of the African countries in the FAO/OECD project sample, the TRI and WRI can provide at least partial equilibrium indicators of the effect of national policies in reducing agricultural trade and national economic welfare.

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Box 1: TRI and WRI expressions

<table>
<tr><th><u>TRI</u></th><th><u>WRI</u></th></tr>
<tr><td>$T = \{Ra + Sb\}$, with

$R = \left[\sum_{i=1}^{n} r_i u_i \right]$ and $S = \left[\sum_{i=1}^{n} s_i v_i \right]$</td><td>$W = \{R'^2 a + S'^2 b\}^{1/2}$, with

$R' = \left[\sum_{i=1}^{n} r_i^2 u_i \right]^{1/2}$ and $S' = \left[\sum_{i=1}^{n} s_i^2 v_i \right]^{1/2}$</td></tr>
<tr><td colspan="2">where $u_i = p_i^{*2} dx_i / dp_i^C / \sum_i p_i^{*2} dx_i / dp_i^C = \rho_i (p_i^* x_i) / \sum_i \rho_i (p_i^* x_i)$

$v_i = p_i^{*2} dy_i / dp_i^P / \sum_i p_i^{*2} dy_i / dp_i^P = \sigma_i (p_i^* y_i) / \sum_i \sigma_i (p_i^* y_i)$,

$a = \sum_i p_i^{*2} \mathrm{dx}_i / \mathrm{d} p_i^C / \sum_i p_i^{*2} \mathrm{d}m_i / \mathrm{d}p_i$, and $b = -\sum_i p_i^{*2} \mathrm{dy}_i / \mathrm{d} p_i^P / \sum_i p_i^{*2} \mathrm{d}m_i / \mathrm{d}p_i$.</td></tr>
<tr><td colspan="2">Variable definitions:
T — Trade Reduction Index; W — Welfare Reduction Index; R — weighted-average consumer price distortions; S — weighted-average producer price distortions; R' — Consumer Distortion Index (CDI); S' — Producer Distortion Index (PDI); s_i — the rate of distortion of the producer price in proportional terms; r_i — rate of distortion of the consumer price in proportional terms; u_i — weight for each commodity in R and R', which is proportional to the marginal response of domestic consumption to changes in international free-trade prices and can be written as a function of prices, demand quantities and domestic price elasticity (at the protected trade situation) of demand (ρ_i); v_i — weight for each commodity in S and S', which is proportional to the marginal response of domestic production to changes in international free-trade prices and can be written as a function of prices, supply quantities and domestic price elasticity (at the protected trade situation) of supply, (σ_i); p_i^* — border price; $p_i^P = p_i^*(1 + s_i)$ — distorted domestic price; $p_i^C = p_i^*(1 + r_i)$ — distorted domestic consumer price; $x_i = x_i(p_i^C)$ — quantity of good i demanded (as a function of own domestic price); $y_i = y_i(p_i^P)$ — quantity of good i supplied (as a function of own domestic price); a (b) — weight of consumption (production) in the WRI or TRI, which is proportional to the ratio of the marginal response of domestic demand (supply) to a price change relative to the marginal response of imports to a price change.</td></tr>
</table>

Source: Authors’ compilation from Lloyd, Croser and Anderson (2010).

Table 1: Nominal rates of assistance, OECD countries, all covered products, 1960 to 2007 (percent)

	1960-69	1970-79	1980-89	1990-99	2000-07
Western European Countries					
European Union	**72**	**58**	**79**	**49**	**26**
EFTA	**62**	**56**	**111**	**178**	**144**
Austria	53	21	40	66	33
Denmark	41	60	83	48	26
Finland	117	90	97	105	32
France	64	49	78	52	25
Germany	110	72	88	56	30
Iceland	—	—	277	219	137
Ireland	60	70	131	81	54
Italy	40	35	56	36	18
Netherlands	107	95	98	53	34
Norway	—	—	293	237	147
Portugal	11	22	30	29	19
Spain	16	-4	28	35	19
Sweden	134	90	92	75	32
Switzerland	—	—	296	258	143
UK	64	56	93	62	33
Europe's transition economies	—	—	—	**9**	**18**
Bulgaria	—	—	—	-16	2
Czech Republic	—	—	—	17	21
Estonia	—	—	—	0	20
Hungary	—	—	—	16	21
Latvia	—	—	—	5	28
Lithuania	—	—	—	2	27
Poland	—	—	—	15	15
Romania	—	—	—	23	45
Russia	—	—	—	1	12
Slovakia	—	—	—	23	21
Slovenia	—	—	—	67	52
Turkey	—	—	—	20	24
Ukraine	—	—	—	-13	-9
North America	**6**	**6**	**15**	**10**	**10**
Canada	8	11	26	17	13
US	6	6	14	9	10
Japan & Korea	**62**	**87**	**135**	**156**	**143**
Japan	73	94	133	148	132
Korea	10	61	145	192	189
Oceania	**8**	**7**	**9**	**3**	**0**
Australia	10	7	6	4	0
New Zealand	2	10	17	2	2

Source: Authors' calculations based on data in Anderson and Valenzuela (2008)

Table 2: Consumer tax equivalents, OECD Countries, all covered products, 1960 to 2007 (percent)

	1960-69	1970-79	1980-89	1990-99	2000-07
Western European Countries					
European Union	**71**	**57**	**68**	**38**	**24**
EFTA	**57**	**52**	**97**	**137**	**113**
Austria	82	23	42	64	28
Denmark	41	68	74	43	24
Finland	128	92	123	124	31
France	64	52	69	39	24
Germany	101	67	70	38	24
Iceland	—	—	172	164	98
Ireland	42	84	120	64	35
Italy	43	36	52	32	20
Netherlands	103	89	97	52	30
Norway	—	—	57	115	101
Portugal	14	23	29	29	20
Spain	19	-2	20	27	18
Sweden	120	92	107	77	35
Switzerland	—	—	171	179	121
UK	55	52	83	49	33
Europe's transition economies	—	—	—	**0**	**15**
Bulgaria	—	—	—	-15	5
Czech Republic	—	—	—	21	22
Estonia	—	—	—	-1	15
Hungary	—	—	—	16	19
Latvia	—	—	—	15	32
Lithuania	—	—	—	1	25
Poland	—	—	—	3	22
Romania	—	—	—	5	34
Russia	—	—	—	-12	19
Slovakia	—	—	—	14	17
Slovenia	—	—	—	53	36
Turkey	—	—	—	15	12
Ukraine	—	—	—	-12	-1
North America	**7**	**7**	**11**	**-1**	**-1**
Canada	9	13	29	19	16
US	7	6	9	-4	-2
Japan & Korea	**55**	**74**	**117**	**125**	**107**
Japan	65	80	113	118	97
Korea	10	52	131	161	147
Oceania	**12**	**11**	**10**	**6**	**2**
Australia	17	11	8	7	2
New Zealand	3	10	15	3	2

Source: Authors' calculations based on data in Anderson and Valenzuela (2008)

Table 3: Trade reduction indexes, OECD countries, all covered products, 1960 to 2007 (percent)

	1960-69	1970-79	1980-89	1990-99	2000-07
Western European Countries					
European Union	**73**	**53**	**71**	**40**	**24**
EFTA	**40**	**27**	**24**	**27**	**57**
Austria	67	22	2	15	30
Denmark	-35	29	72	44	24
Finland	28	-8	-43	-51	31
France	66	46	70	41	23
Germany	105	65	77	45	26
Iceland	—	—	59	23	40
Ireland	-8	51	123	72	44
Italy	47	33	50	28	18
Netherlands	104	91	97	52	32
Norway	—	—	60	175	120
Portugal	**13**	**22**	**26**	**23**	**18**
Spain	20	-1	23	27	17
Sweden	44	47	-11	-6	33
Switzerland	—	—	124	31	23
UK	59	50	86	54	33
Europe's transition economies	—	—	—	**9**	**11**
Bulgaria	—	—	—	10	8
Czech Republic	—	—	—	-7	7
Estonia	—	—	—	11	4
Hungary	—	—	—	-9	-17
Latvia	—	—	—	26	17
Lithuania	—	—	—	22	-5
Poland	—	—	—	10	-12
Romania	—	—	—	16	37
Russia	—	—	—	-2	22
Slovakia	—	—	—	3	3
Slovenia	—	—	—	-13	-20
Turkey	—	—	—	19	13
Ukraine	—	—	—	14	12
North America	**4**	**3**	**8**	**5**	**4**
Canada	7	10	22	17	13
US	3	2	7	4	3
Japan & Korea	**58**	**81**	**126**	**140**	**118**
Japan	69	87	123	133	112
Korea	10	56	138	177	144
Oceania	**-5**	**-4**	**-5**	**-3**	**0**
Australia	-9	-4	-5	-5	-1
New Zealand	2	-3	-6	2	1

Source: Authors' calculations based on data in Anderson and Valenzuela (2008)

Table 4: Welfare reduction indexes, OECD Countries, all covered products, 1960 to 2007 (percent)

	1960-69	1970-79	1980-89	1990-99	2000-07
Western European Countries					
European Union	**114**	**110**	**119**	**62**	**42**
EFTA	**125**	**111**	**145**	**181**	**148**
Austria	92	41	60	83	47
Denmark	80	122	128	63	39
Finland	133	118	134	133	47
France	105	106	120	64	43
Germany	144	121	126	66	43
Iceland	—	—	274	238	167
Ireland	86	142	174	84	59
Italy	89	81	96	55	38
Netherlands	148	149	148	70	46
Norway	—	—	227	201	147
Portugal	26	44	50	49	37
Spain	44	33	59	51	35
Sweden	172	174	150	92	50
Switzerland	—	—	268	240	149
UK	144	127	132	72	50
Europe's transition economies	—	—	—	**40**	**42**
Bulgaria	—	—	—	27	25
Czech Republic	—	—	—	33	35
Estonia	—	—	—	27	28
Hungary	—	—	—	34	41
Latvia	—	—	—	50	52
Lithuania	—	—	—	53	53
Poland	—	—	—	28	34
Romania	—	—	—	40	60
Russia	—	—	—	39	34
Slovakia	—	—	—	31	33
Slovenia	—	—	—	69	57
Turkey	—	—	—	53	53
Ukraine	—	—	—	35	26
North America	**16**	**14**	**35**	**23**	**23**
Canada	15	32	83	46	38
US	17	12	30	20	22
Japan & Korea	**77**	**119**	**190**	**221**	**192**
Japan	84	130	198	225	190
Korea	44	77	153	202	203
Oceania	**25**	**22**	**20**	**14**	**5**
Australia	31	24	17	14	3
New Zealand	12	17	27	13	9

Source: Authors' calculations based on data in Anderson and Valenzuela (2008)

Table 5: Comparison of WRI and TRI estimates with and without simplifying elasticity assumption, sub-set of covered products,[a] 1960 to 2007 (percent)

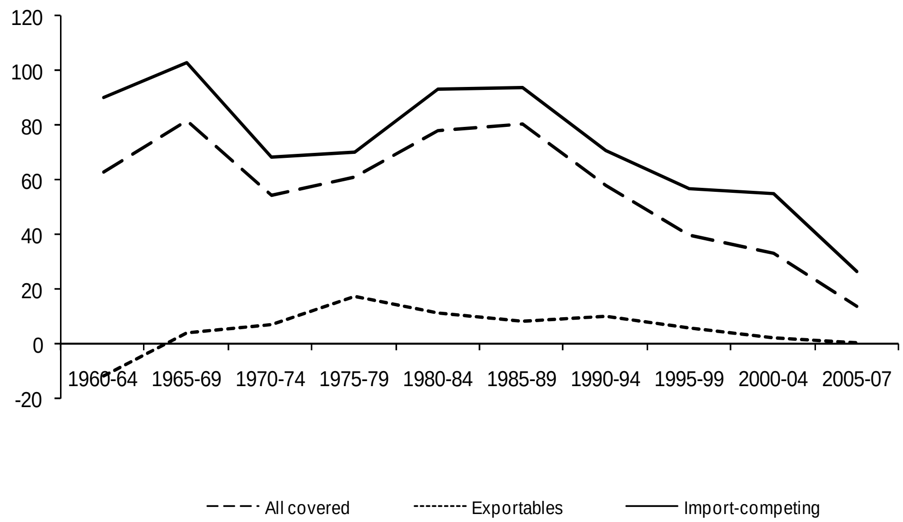
	Using elasticity data for subset of products for which data are available					With simplifying elasticity assumption and for a sub-set of products[a]					Comparison (percentage point difference between (1)-(5) and (6)-(10)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	1960-69	1970-79	1980-89	1990-99	2000-07	1960-69	1970-79	1980-89	1990-99	2000-07	1960-69	1970-79	1980-89	1990-99	2000-07
Trade Reduction Indexes															
EU	68	51	65	34	22	75	55	74	40	24	7	3	10	6	2
EFTA	37	24	25	24	55	41	29	25	27	57	4	4	0	3	2
ECA	na	na	na	5	7	na	na	na	8	11	-	-	-	4	4
NA	1	1	3	3	2	4	3	8	5	4	2	2	5	2	2
Japan & Korea	50	61	99	124	103	58	81	137	163	128	8	20	38	39	25
Oceania	-2	-2	-4	-1	0	-5	-4	-6	-3	0	-3	-1	-2	-2	0
Welfare Reduction Indexes															
EU	103	102	109	57	40	116	113	123	62	42	13	11	14	6	2
EFTA	108	100	138	173	147	126	113	146	181	148	18	13	8	8	1
ECA	na	na	na	39	45	na	na	na	41	43	-	-	-	2	-1
NA	13	11	27	19	20	16	14	35	23	23	4	3	9	4	4
Japan & Korea	70	101	162	201	171	77	119	201	246	205	6	18	39	46	34
Oceania	20	19	16	10	4	24	23	20	14	5	5	4	4	4	1

Sources: Authors' calculations based on data in Anderson and Valenzuela (2008) and elasticity estimates from Roningen (2001) and Tyers and Anderson (1992).

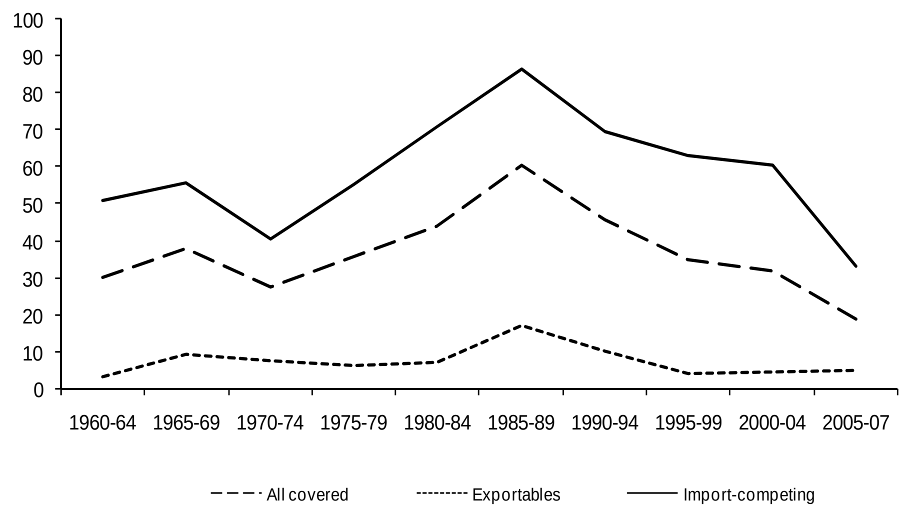
a. The TRI and WRI estimates in these columns are for a sub-set of farm products for which we have elasticity data (so as to enable direct comparison of the results with and without the simplifying elasticity assumption).

Figure 1: Nominal rate of assistance, OECD countries, 1960 to 2007 (percent)

(a) EU countries



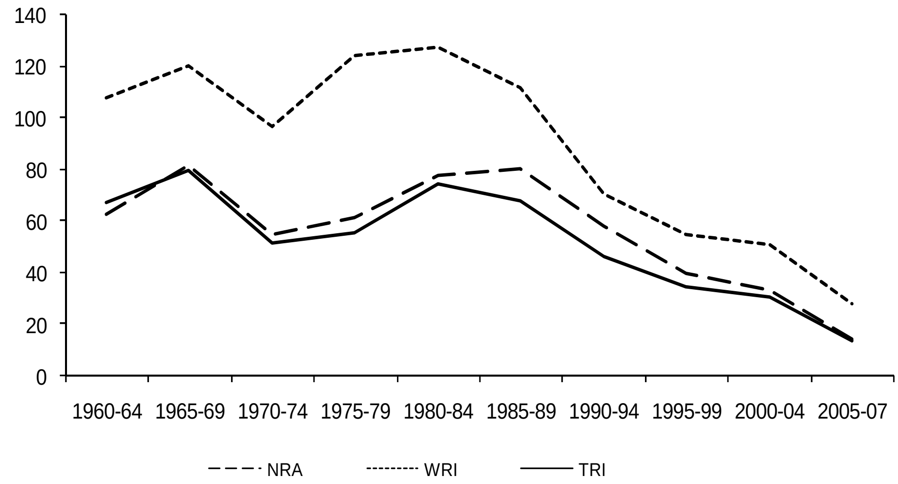
(b) All OECD sample countries



Sources: Authors' calculations based on data in Anderson and Valenzuela (2008).

Figure 2: Nominal rate of assistance, trade and welfare reduction indexes, OECD countries, 1960 to 2007 (percent)

(a) EU countries



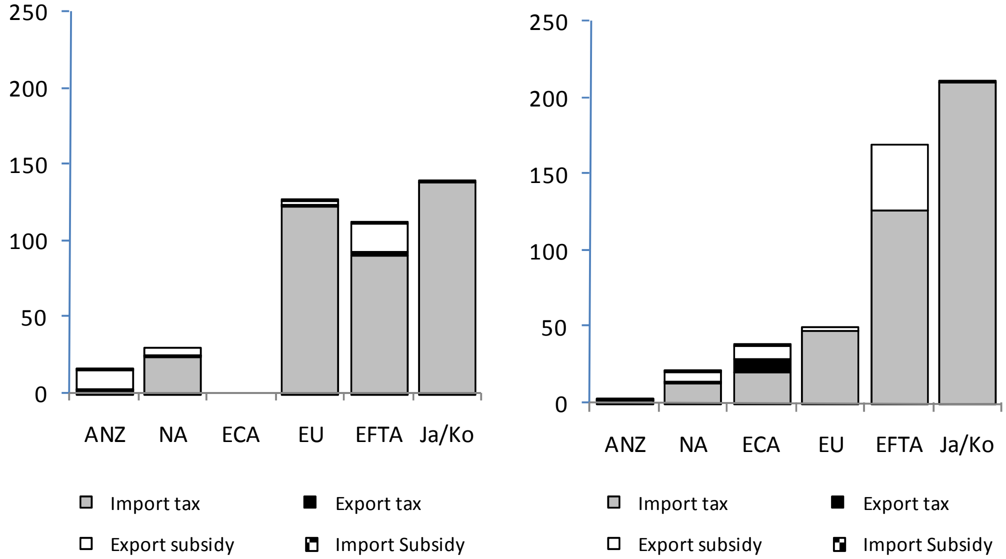
(b) All OECD sample countries

Sources: Authors' calculations based on data in Anderson and Valenzuela (2008).

Figure 3: Decomposition of indices by policy instrument, 1980-84 and 2000-04
(percent)

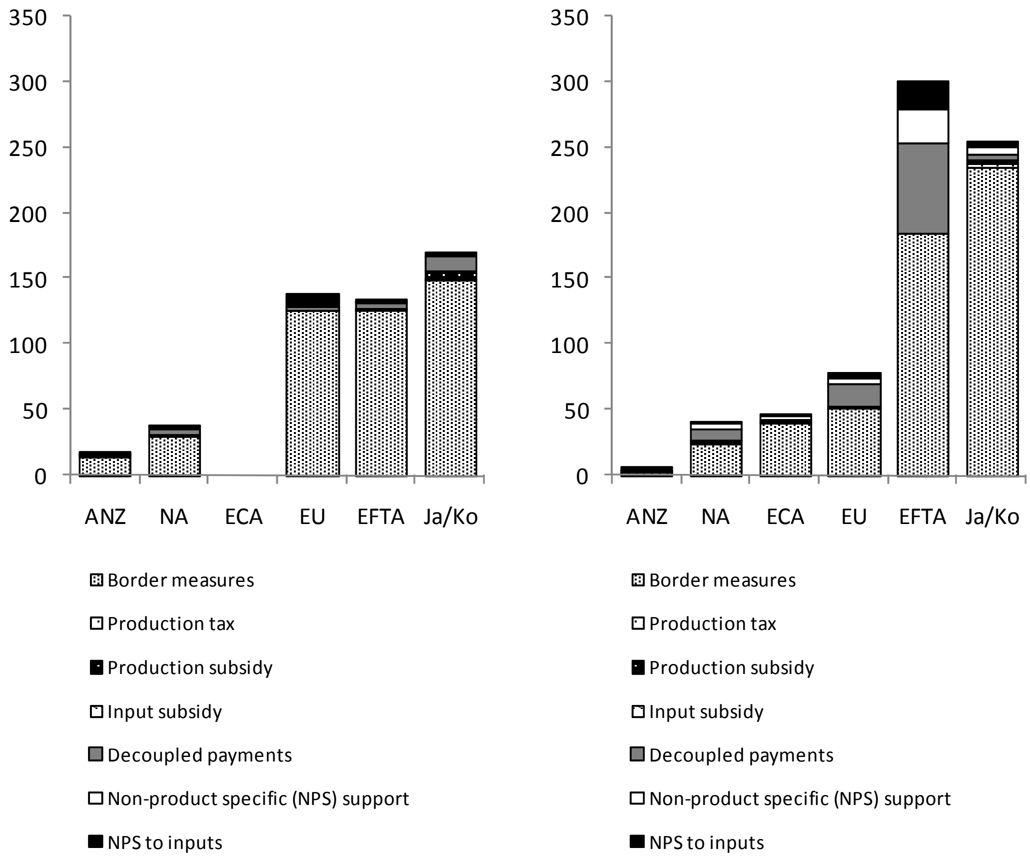
(a) Decomposition of WRI, border measure only components

1980–84 2000–04



(b) Decomposition of PDI, border and domestic components

1980–84 2000–04



Source: Authors' calculations based on data in Anderson and Valenzuela (2008).

Figure 4: OECD commodity market welfare reduction indexes, 1980–84 and 2000–04

(percent)

(a) 34 focus countries

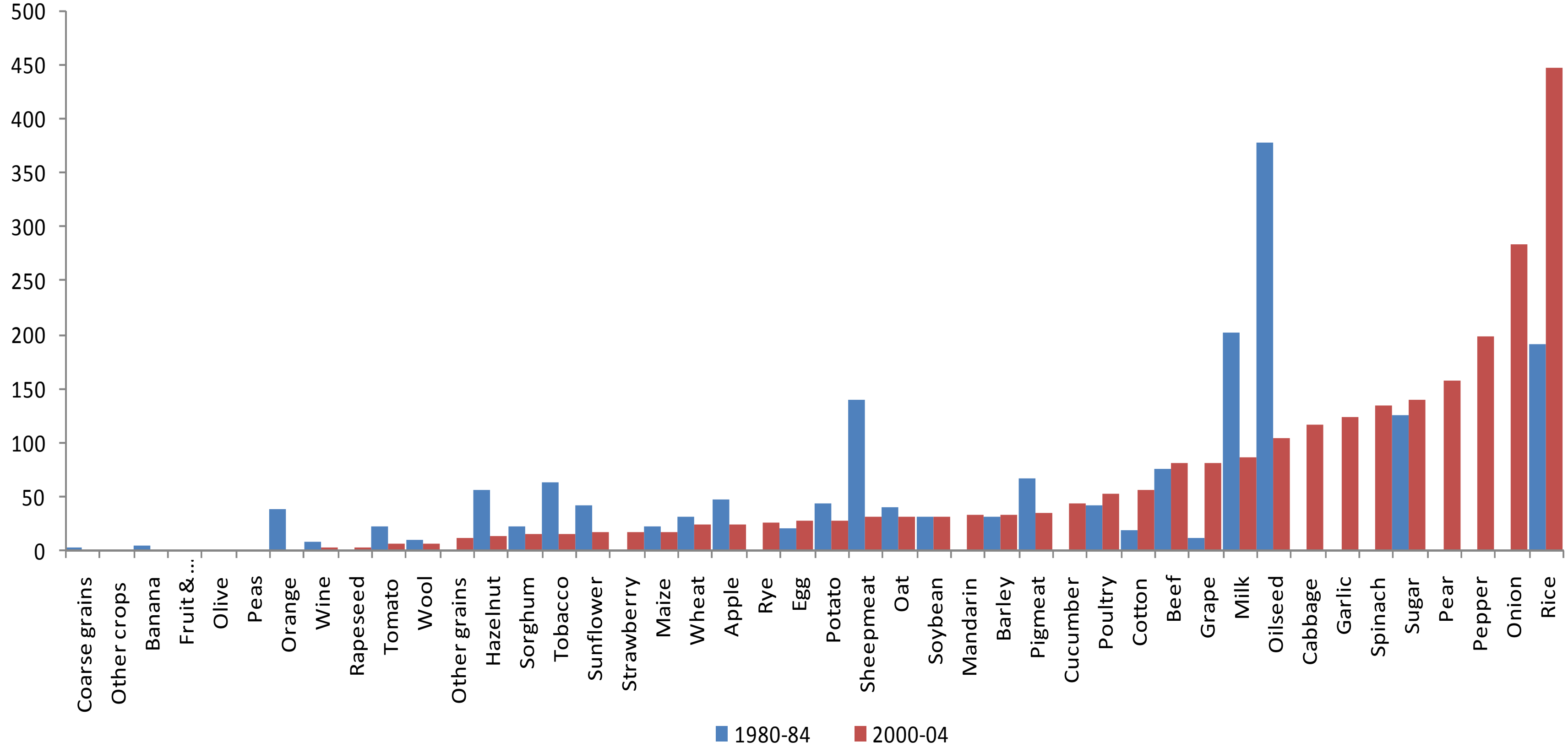
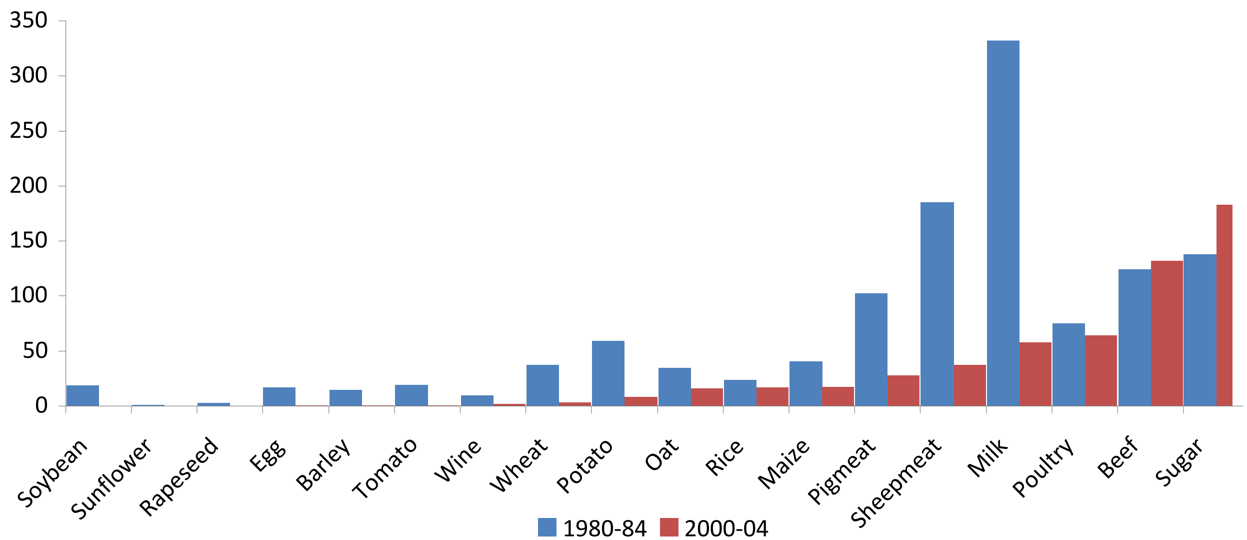


Figure 4 (continued): OECD commodity market welfare reduction indexes, 1980–84 and 2000–04

(percent)

(b) Western European countries



Source: Authors' calculations based on data in Anderson and Valenzuela (2008).

Appendix Table 1: EU and EFTA members represented in the Agricultural Distortions database

(a) European Union (EU) members represented[a]

Year	**Countries**
1956	France, Germany, Italy, Netherlands,
1973	plus UK, Ireland, Denmark
1986	plus Portugal, Spain
1995	plus Austria, Sweden, Finland

(a) European Free Trade Association (EFTA) members represented

Year	**Countries**
1960	Austria, Denmark, Norway, Portugal, Sweden, Switzerland, UK
1970	Austria, Denmark, Norway, Portugal, Sweden, Switzerland, UK, Finland, Iceland
1973	Austria, Norway, Portugal, Sweden, Switzerland, Finland and Iceland
1986	Austria, Norway, Sweden, Switzerland, Finland and Iceland
1995	Norway, Switzerland and Iceland

[a] Several of Europe's transition economies joined the EU in 2004 and 2007. These countries are not included in the EU aggregates provided in this paper, but instead are included as part of the Eastern Europe and Central Asia (ECA) aggregation. Also not included at Cyprus and Malta, which joined the EU in 2004.

Source: Authors' aggregations.

Appendix Table 2: OECD commodity market trade reduction indexes, 44 covered farm products, 1960 to 2004 (percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04
Grains	**22**	**24**	**13**	**21**	**25**	**64**	**63**	**38**	**35**
Barley	36	31	3	-14	-1	37	32	10	4
Coarse grains	-4	-4	-4	-4	-4	-2	0	0	0
Maize	3	6	3	10	4	7	12	7	7
Oat	15	9	-8	-3	-10	-2	-2	13	9
Other crops	0	0	0	0	0	0	0	0	0
Other grains	na	na	na	na	na	na	10	18	12
Rice	60	73	95	125	165	357	404	326	374
Rye	na	na	na	na	na	na	2	1	14
Sorghum	0	0	0	-1	-15	-3	6	5	7
Wheat	17	15	-3	0	12	31	28	5	7
Oilseeds	**0**	**0**	**-1**	**2**	**6**	**15**	**11**	**5**	**1**
Hazelnut	na	na	na	17	57	47	40	31	4
Oilseed	na	na	na	310	343	468	286	41	47
Rapeseed	-4	-2	-1	-1	-1	31	16	0	0
Soybean	0	1	-1	2	5	6	5	2	0
Sunflower	0	-5	-12	-16	-31	41	28	16	11
Tropical Crops	**29**	**61**	**2**	**35**	**50**	**63**	**43**	**47**	**46**
Cotton	1	-44	-29	-6	-8	-4	2	6	-12
Sugar	102	217	17	81	109	164	99	105	111
Tobacco	45	48	68	45	63	11	-25	-37	11
Livestock	**39**	**41**	**37**	**47**	**58**	**52**	**37**	**37**	**34**
Beef	24	21	18	16	39	53	41	45	42
Egg	-8	-4	-7	10	9	14	11	13	8
Milk	88	92	87	143	148	133	76	73	56
Pigmeat	27	37	29	26	34	11	7	15	15
Poultry	22	20	28	26	26	25	29	25	26
Sheepmeat	64	80	110	167	98	72	43	20	20
Wool	0	0	-6	-4	-7	-2	-4	0	0
Fruit &vegetables	**11**	**5**	**7**	**18**	**13**	**10**	**8**	**12**	**11**
Apple	-6	8	28	44	43	21	19	14	18
Banana	0	0	0	0	5	1	0	0	0
Cabbage	na	na	na	na	na	17	28	79	90
Cucumber	na	na	na	na	na	57	17	30	43
Fruit & vegetables	0	0	0	0	0	0	0	0	0
Garlic	na	na	na	na	na	250	289	213	123
Grape	7	10	-4	5	8	16	18	31	22
Mandarin	na	na	na	na	na	21	45	47	32

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04
Olive	0	0	0	0	0	0	0	0	0
Onion	na	na	na	na	na	55	81	144	284
Orange	25	25	26	33	38	13	3	1	1
Pear	na	na	na	na	na	35	24	64	157
Peas	0	0	0	0	0	0	0	0	0
Pepper	na	na	na	na	na	175	245	146	197
Potato	24	19	16	48	27	9	8	4	0
Spinach	na	na	na	na	na	89	138	237	134
Strawberry	na	na	na	na	na	11	25	26	17
Tomato	-4	20	21	21	19	8	-5	3	2
Wine	10	-3	-3	-4	-9	-2	-10	-4	-2

Source: Authors’ calculations based on data in Anderson and Valenzuela (2008).

Appendix Table 3: OECD commodity market welfare reduction indexes, 44 covered farm products, 1960 to 2004 (percent)

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04
Grains	**39**	**48**	**38**	**47**	**48**	**103**	**96**	**61**	**55**
Barley	52	49	35	41	32	98	88	45	33
Coarse grains	4	4	4	4	4	2	0	0	0
Maize	16	21	16	23	23	29	26	15	17
Oat	52	72	63	105	41	67	70	33	31
Other crops	0	0	0	0	0	0	0	0	0
Other grains	na	na	na	na	na	na	11	18	12
Rice	75	92	118	149	192	429	481	391	447
Rye	na	na	na	na	na	na	35	26	25
Sorghum	0	0	0	2	24	12	9	11	15
Wheat	35	45	25	21	31	63	57	28	23
Oilseeds	**4**	**6**	**9**	**14**	**31**	**41**	**34**	**24**	**26**
Hazelnut	na	na	na	21	57	47	40	31	12
Oilseed	na	na	na	354	378	472	352	113	103
Rapeseed	17	7	4	3	2	62	44	4	2
Soybean	4	6	9	14	31	32	29	28	31
Sunflower	10	9	16	24	43	69	49	23	16
Tropical Crops	**49**	**133**	**46**	**52**	**69**	**99**	**74**	**77**	**90**
Cotton	7	58	39	16	19	40	36	38	55
Sugar	161	288	46	100	126	192	123	128	139
Tobacco	46	48	97	52	63	22	36	45	15
Livestock	**78**	**80**	**72**	**86**	**92**	**94**	**75**	**64**	**61**
Beef	47	39	37	45	76	102	86	83	80
Egg	46	46	31	19	20	40	37	38	27
Milk	161	163	149	233	202	211	127	102	86
Pigmeat	50	77	63	57	67	35	35	32	34
Poultry	37	33	46	39	43	48	58	48	51
Sheepmeat	103	144	180	216	140	116	76	39	30
Wool	0	0	6	7	11	7	10	8	6
Fruit &vegetables	**28**	**20**	**17**	**30**	**26**	**20**	**21**	**19**	**22**
Apple	6	16	35	49	48	24	21	21	24
Banana	0	0	0	0	5	1	0	0	0
Cabbage	na	na	na	na	na	21	34	93	116
Cucumber	na	na	na	na	na	57	17	30	43
Fruit & vegetables	0	0	0	0	0	0	0	0	0
Garlic	na	na	na	na	na	250	289	213	123
Grape	59	29	19	11	13	42	51	64	81
Mandarin	na	na	na	na	na	21	45	47	32

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04
Olive	0	0	0	0	0	0	0	0	0
Onion	na	na	na	na	na	55	81	144	284
Orange	25	25	26	33	38	13	3	1	1
Pear	na	na	na	na	na	35	24	64	157
Peas	0	0	0	0	0	0	0	0	0
Pepper	na	na	na	na	na	175	245	146	197
Potato	80	79	35	74	45	17	17	13	28
Spinach	na	na	na	na	na	89	138	237	134
Strawberry	na	na	na	na	na	11	25	26	17
Tomato	16	25	28	26	23	19	8	9	6
Wine	18	4	4	4	10	11	10	4	2

Source: Authors’ calculations based on data in Anderson and Valenzuela (2008).

Appendix Table 4: Elasticities of supply, 27 key covered farm products, OECD member countries and transition economies

	Australia	Austria	Bulgaria	Canada	Czech Rep	Denmark	Estonia	Finland	France	Germany	Hungary	Iceland
Barley	0.93	0.60	0.80	0.99	0.80	0.70	0.80	0.60	0.70	0.70	0.80	-
Beef	0.70	0.57	0.30	0.50	0.30	0.55	0.30	0.57	0.55	0.55	0.30	0.57
Cotton	0.50	-	-	-	-	-	-	-	-	-	-	-
Egg	0.60	0.75	0.35	0.55	0.35	0.75	0.35	0.75	0.75	0.75	0.35	0.75
Hazelnut	-	-	-	-	-	-	-	-	-	-	-	-
Maize	0.80	0.65	0.30	0.48	0.30	-	-	-	0.60	0.60	0.30	-
Milk	0.50	0.60	0.30	0.50	0.30	0.65	0.30	0.60	0.65	0.65	0.30	0.60
Oat	0.93	0.60	0.80	-	0.80	0.70	0.80	0.60	0.70	0.70	0.80	-
Oilseeds	0.60	-	-	-	-	-	0.30	-	-	-	-	-
Pigmeat	0.80	0.80	0.45	1.50	0.45	0.90	0.45	0.80	0.90	0.90	0.45	0.80
Potato	0.93	0.60	0.80	0.99	0.80	0.70	0.80	0.60	0.70	0.70	0.80	-
Poultry	0.80	0.75	0.70	0.70	0.70	0.80	0.70	0.75	0.80	0.80	0.70	0.75
Rapeseed	0.60	0.30	0.30	0.55	0.30	0.75	-	-	0.75	0.75	0.30	-
Rice	0.60	-	0.30	-	-	-	-	-	0.35	-	0.30	-
Rye	-	-	-	-	-	-	0.80	-	-	-	-	-
Sheepmeat	0.70	0.80	0.35	-	0.35	0.70	0.35	0.80	0.70	0.70	0.35	0.80
Sorghum	0.93	-	-	-	-	-	-	-	-	-	-	-
Soybean	0.50	-	0.45	0.60	0.45	-	-	-	0.40	0.40	0.45	-
Sugar	0.50	0.45	0.20	0.50	0.20	0.15	-	0.45	0.15	0.15	0.20	-
Sunflower	0.60	0.30	0.30	-	0.30	-	-	-	0.75	0.75	0.30	-
Tobacco	0.50	-	-	-	-	-	-	-	-	-	-	-
Wheat	0.90	0.80	0.25	0.60	0.25	0.50	0.25	0.80	0.50	0.50	0.25	-
Wine	-	0.20	0.20	-	-	-	-	-	0.20	0.20	0.20	-
Wool	0.70	-	-	-	-	-	-	-	-	-	-	0.80

	Ireland	Italy	Japan	Korea	Latvia	Lithuania	Netherlands	New Zealand	Norway	Poland	Portugal	Romania
Barley	0.70	0.70	0.62	0.37	0.80	0.80	0.70	0.80	0.60	0.80	0.70	0.80
Beef	0.55	0.55	0.40	0.50	0.30	0.30	0.55	0.45	0.57	0.30	0.55	0.30
Cotton	-	-	-	-	-	-	-	-	-	-	-	-
Egg	0.75	0.75	0.80	0.80	0.35	0.35	0.75	0.80	0.75	0.35	0.75	0.35
Hazelnut	-	-	-	-	-	-	-	-	-	-	-	-
Maize	-	0.60	-	-	-	0.30	0.60	0.90	-	0.30	0.60	0.30
Milk	0.65	0.65	0.40	0.80	0.30	0.30	0.65	0.60	0.60	0.30	0.65	0.30
Oat	0.70	0.70	-	-	0.80	0.80	0.70	0.80	0.60	0.80	0.70	0.80
Oilseed	-	-	-	-	0.30	0.30	-	-	-	0.30	-	-
Pigmeat	0.90	0.90	0.88	0.70	0.45	0.45	0.90	0.80	0.80	0.45	0.90	0.45
Potato	0.70	0.70	-	-	0.80	0.80	0.70	-	-	0.80	0.70	0.80
Poultry	0.80	0.80	1.27	0.90	0.70	0.70	0.80	0.80	0.75	0.70	0.80	0.70
Rapeseed	0.75	0.75	-	-	-	-	0.75	-	-	-	-	0.30
Rice	-	0.35	0.50	0.35	-	-	-	-	-	-	0.35	0.30
Rye	-	-	-	-	0.80	0.80	-	-	-	-	-	-
Sheepmeat	0.70	0.70	-	-	0.35	0.35	0.70	0.90	0.80	0.35	0.70	0.35
Sorghum	-	-	-	-	-	-	-	-	-	-	-	-
Soybean	-	0.40	0.65	0.36	-	-	-	-	-	0.45	-	0.45
Sugar	0.15	0.15	0.45	-	0.20	0.20	0.15	-	-	0.20	0.15	0.20
Sunflower	-	0.75	-	-	-	-	-	-	-	0.30	0.75	0.30
Tobacco	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0.50	0.50	0.52	0.45	0.25	0.25	0.50	0.80	0.80	0.25	0.50	0.25
Wine	-	0.20	-	-	-	-	-	-	-	-	0.20	0.20
Wool	-	-	-	-	-	-	-	0.90	0.80	-	-	-

	Russia	Slovakia	Slovenia	Spain	Sweden	Switzerland	Turkey	UK	Ukraine	US
Barley	0.24	0.80	0.80	0.70	0.60	0.60	0.80	0.70	0.80	0.99
Beef	0.25	0.30	0.30	0.55	0.57	0.57	0.30	0.55	0.30	0.60
Cotton	-	-	-	-	-	-	0.15	-	-	0.74
Egg	0.25	0.35	0.35	0.75	0.75	0.75	0.35	0.75	0.35	0.55
Hazelnut	-	-	-	-	-	-	0.20	-	-	-
Maize	0.38	0.30	0.30	0.60	-	0.65	0.30	-	0.30	0.48
Milk	0.20	0.30	0.30	0.65	0.60	0.60	0.30	0.65	0.30	0.50
Oat	0.24	0.80	-	0.70	0.60	0.60	-	0.70	0.80	-
Oilseed	-	-	-	-	-	0.30	-	-	-	-
Pigmeat	0.40	0.45	0.45	0.90	0.80	0.80	-	0.90	0.45	1.00
Potato	-	0.80	-	0.70	0.60	-	0.80	0.70	0.80	0.99
Poultry	0.50	0.70	0.70	0.80	0.75	0.75	0.70	0.80	0.70	0.65
Rapeseed	-	0.30	-	0.75	0.30	-	-	0.75	-	-
Rice	-	-	-	0.35	-	-	0.30	-	-	0.40
Rye	0.24	0.80	-	-	-	-	-	-	0.80	-
Sheepmeat	-	0.35	0.35	0.70	0.80	0.80	0.35	0.70	-	0.80
Sorghum	-	-	-	-	-	-	-	-	-	0.99
Soybean	-	0.45	-	0.40	-	-	-	-	-	0.60
Sugar	0.16	0.20	0.20	0.15	0.45	0.45	0.20	0.15	0.20	0.50
Sunflower	0.15	0.30	-	0.75	-	-	0.30	-	0.30	-
Tobacco	-	-	-	-	-	-	0.20	-	-	-
Wheat	0.23	0.25	0.25	0.50	0.80	0.80	0.25	0.50	0.25	0.60
Wine	-	0.20	-	0.20	-	-	-	-	-	-
Wool	-	-	-	-	-	-	-	-	-	0.80

Sources: Authors’ compilation from Roningen (2001) and Tyers and Anderson (1992, Appendix Tables A2 to A4).

Appendix Table 5: Elasticities of demand (absolute value), 27 key covered farm products, OECD member countries and transition economies

	Australia	Austria	Bulgaria	Canada	Czech Rep	Denmark	Estonia	Finland	France	Germany	Hungary	Iceland
Barley	0.64	0.77	0.68	1.07	0.68	0.91	0.68	0.77	0.91	0.91	0.68	-
Beef	0.78	0.70	0.20	0.80	0.20	0.70	0.20	0.70	0.70	0.70	0.20	0.70
Cotton	0.20	-	-	-	-	-	-	-	-	-	-	-
Egg	0.25	0.35	0.10	0.30	0.10	0.20	0.10	0.35	0.20	0.20	0.10	0.35
Hazelnut	-	-	-	-	-	-	-	-	-	-	-	-
Maize	0.68	1.11	0.66	1.03	0.66	-	-	-	1.06	1.06	0.66	-
Milk	0.16	0.15	0.14	0.15	0.14	0.16	0.14	0.15	0.16	0.16	0.14	0.15
Oat	0.64	0.77	0.68	-	0.68	0.91	0.68	0.77	0.91	0.91	0.68	-
Oilseeds	0.38	-	-	-	-	-	0.72	-	-	-	-	-
Pigmeat	1.02	0.60	0.50	0.86	0.50	0.80	0.50	0.60	0.80	0.80	0.50	0.60
Potato	0.64	0.77	0.68	1.07	0.68	0.91	0.68	0.77	0.91	0.91	0.68	-
Poultry	0.80	0.65	0.25	0.67	0.25	0.90	0.25	0.65	0.90	0.90	0.25	0.65
Rapeseed	0.38	0.27	0.72	0.45	0.72	0.35	-	-	0.35	0.35	0.72	-
Rice	0.45	-	0.15	-	-	-	-	-	0.50	-	0.15	-
Rye	-	-	-	-	-	-	0.68	-	-	-	-	-
Sheepmeat	1.20	0.47	0.28	-	0.28	0.90	0.28	0.47	0.90	0.90	0.28	0.47
Sorghum	0.64	-	-	-	-	-	-	-	-	-	-	-
Soybean	0.25	-	0.13	0.26	0.13	-	-	-	0.16	0.16	0.13	-
Sugar	0.25	0.29	0.30	0.24	0.30	0.50	-	0.29	0.50	0.50	0.30	-
Sunflower	0.38	0.27	0.72	-	0.72	-	-	-	0.35	0.35	0.72	-
Tobacco	0.50	-	-	-	-	-	-	-	-	-	-	-
Wheat	0.39	0.53	0.37	0.57	0.37	0.57	0.37	0.53	0.57	0.57	0.37	-
Wine	-	0.50	0.50	-	-	-	-	-	0.50	0.50	0.50	-
Wool	1.20	-	-	-	-	-	-	-	-	-	-	0.47

	Ireland	Italy	Japan	Korea	Latvia	Lithuania	Netherlands	New Zealand	Norway	Poland	Portugal	Romania
Barley	0.91	0.91	1.32	0.74	0.68	0.68	0.91	0.64	0.77	0.68	0.91	0.68
Beef	0.70	0.70	1.00	0.80	0.20	0.20	0.70	0.60	0.70	0.20	0.70	0.20
Cotton	-	-	-	-	-	-	-	-	-	-	-	-
Egg	0.20	0.20	0.30	0.20	0.10	0.10	0.20	0.60	0.35	0.10	0.20	0.10
Hazelnut	-	-	-	-	-	-	-	-	-	-	-	-
Maize	-	1.06	-	-	-	0.66	1.06	0.89	-	0.66	1.06	0.66
Milk	0.16	0.16	0.19	0.80	0.14	0.14	0.16	0.01	0.15	0.14	0.16	0.14
Oat	0.91	0.91	-	-	0.68	0.68	0.91	0.64	0.77	0.68	0.91	0.68
Oilseed	-	-	-	-	0.72	0.72	-	-	-	0.72	-	-
Pigmeat	0.80	0.80	0.95	0.90	0.50	0.50	0.80	0.55	0.60	0.50	0.80	0.50
Potato	0.91	0.91	-	-	0.68	0.68	0.91	-	-	0.68	0.91	0.68
Poultry	0.90	0.90	1.10	0.70	0.25	0.25	0.90	0.60	0.65	0.25	0.90	0.25
Rapeseed	0.35	0.35	-	-	-	-	0.35	-	-	-	-	0.72
Rice	-	0.50	0.25	0.20	-	-	-	-	-	-	0.50	0.15
Rye	-	-	-	-	0.68	0.68	-	-	-	-	-	-
Sheepmeat	0.90	0.90	-	-	0.28	0.28	0.90	0.60	0.47	0.28	0.90	0.28
Sorghum	-	-	-	-	-	-	-	-	-	-	-	-
Soybean	-	0.16	0.14	0.12	-	-	-	-	-	0.13	-	0.13
Sugar	0.50	0.50	0.54	-	0.30	0.30	0.50	-	-	0.30	0.50	0.30
Sunflower	-	0.35	-	-	-	-	-	-	-	0.72	0.35	0.72
Tobacco	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0.57	0.57	0.39	0.61	0.37	0.37	0.57	0.31	0.53	0.37	0.57	0.37
Wine	-	0.50	-	-	-	-	-	-	-	-	0.50	0.50
Wool	-	-	-	-	-	-	-	0.60	0.47	-	-	-

	Russia	Slovakia	Slovenia	Spain	Sweden	Switzerland	Turkey	UK	Ukraine	US
Barley	0.38	0.68	0.68	0.91	0.77	0.77	0.68	0.91	0.68	1.38
Beef	0.19	0.20	0.20	0.70	0.70	0.70	0.20	0.70	0.20	0.70
Cotton	-	-	-	-	-	-	0.15	-	-	0.20
Egg	0.15	0.10	0.10	0.20	0.35	0.35	0.10	0.20	0.10	0.35
Hazelnut	-	-	-	-	-	-	0.50	-	-	-
Maize	0.54	0.66	0.66	1.06	-	1.11	0.66	-	0.66	0.80
Milk	0.15	0.14	0.14	0.16	0.15	0.15	0.14	0.16	0.14	0.16
Oat	0.38	0.68	-	0.91	0.77	0.77	-	0.91	0.68	-
Oilseed	-	-	-	-	-	0.27	-	-	-	-
Pigmeat	0.18	0.50	0.50	0.80	0.60	0.60	-	0.80	0.50	0.86
Potato	-	0.68	-	0.91	0.77	-	0.68	0.91	0.68	1.38
Poultry	0.25	0.25	0.25	0.90	0.65	0.65	0.25	0.90	0.25	0.56
Rapeseed	-	0.72	-	0.35	0.27	-	-	0.35	-	-
Rice	-	-	-	0.50	-	-	0.15	-	-	0.25
Rye	0.38	0.68	-	-	-	-	-	-	0.68	-
Sheepmeat	-	0.28	0.28	0.90	0.47	0.47	0.28	0.90	-	0.70
Sorghum	-	-	-	-	-	-	-	-	-	1.38
Soybean	-	0.13	-	0.16	-	-	-	-	-	0.30
Sugar	0.15	0.30	0.30	0.50	0.29	0.29	0.30	0.50	0.30	0.24
Sunflower	0.37	0.72	-	0.35	-	-	0.72	-	0.72	-
Tobacco	-	-	-	-	-	-	0.50	-	-	-
Wheat	0.29	0.37	0.37	0.57	0.53	0.53	0.37	0.57	0.37	0.49
Wine	-	0.50	-	0.50	-	-	-	-	-	-
Wool	-	-	-	-	-	-	-	-	-	0.70

Sources: Authors' compilation from Roningen (2001) and Tyers and Anderson (1992, Appendix Tables A2 to A4).